Run I/II DØ Luminosity Constants

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Introduction

We call the effective inelastic cross-section the luminosity constant

$$\mathcal{L} = \frac{1}{\sigma_{eff}} \frac{dN}{dt}$$

$$\sigma_{eff} = \epsilon \times A \times \sigma_{inelastic}$$

$$\sigma_{inelastic} \equiv \sigma_{total} - \sigma_{elastic}$$

includes diffraction.

For Run II, we have new numbers for $\sigma_{inelastic}$ and the fraction of diffractive events.

Run I luminosity constant needs to be updated to include these new numbers.

Dependence on $\sigma_{inelastic}$ is trivial. Diffractive fraction plays a big part in determining A.

Procedure

Inelastic and diffractive cross-sections are determined from other experiments.

Acceptance is determined using Monte Carlo.

Inelastic generators do not get the diffractive fraction correct.

$\Rightarrow$ determine the acceptance for each process separately and weight by the measured cross-sections

$$\sigma_{inelastic} = \sigma_{HC} + \sigma_{SD} + \sigma_{DD}$$

HC: non-diffractive, SD: $p + \bar{p} \rightarrow p + X$, DD: $p + \bar{p} \rightarrow X$ w/o color flow (soft, forward)

$$A \times \sigma_{inelastic} = A_{SD}\sigma_{SD} + A_{DD}\sigma_{DD} + A_{HC}(\sigma_{inelastic} - \sigma_{SD} - \sigma_{DD})$$

ϵ determined in zero-bias data using independently tagged inelastic events with particles in our acceptance.

Cross-Sections

	Run II	Run I old	Run I new
inelastic	60.7 ± 2.4 mb	57.55 ± 1.56 mb	59.23 ± 2.3 mb
SD	9.6 ± 0.5 mb	9.57 ± 0.43 mb	9.6 ± 0.5 mb
DD	7.0 ± 2.0 mb	1.29 ± 0.20 mb	7.0 ± 2.0 mb

Run II inelastic is average of CDF and E811 measurements at 1.8 TeV and scaled to 1.96 TeV.

(*S. Klimenko, J. Konigsberg, T.M. Liss*, FERMILAB-FN-0741 (2003).)

Scaling for diffractive is unknown, assumed to be small, not applied.

Run I DD was an estimate based on measured SD value, now DD measurements are available leading to the big change.

Run II Acceptances

Generator Level

	MBR	DTUJET	PHOJET	Pythia
HC	0.911	0.949	0.924	0.943
SD	0.183	0.088	0.280	0.242
DD	0.563	0.642	0.570	0.321
inelastic	0.75	0.78	0.78	0.76

Run I: used average of MBR and DTUJET, error = ± half the difference

Run II: average of MBR and Phythia

$$\delta A_{HC} = \pm\frac{1}{2}|\mathrm{Pythia} - \mathrm{MBR}| \quad \delta A_{SD} = \delta A_{DD} = \pm|\mathrm{Pythia} - \mathrm{MBR}|$$

Acceptances

	Run II	Run I old	Run I new
HC	0.982 ± 0.0125	0.971 ± 0.020	0.971 ± 0.020
SD	0.313 ± 0.137	0.151 ± 0.050	0.151 ± 0.050
DD	0.624 ± 0.130	0.716 ± 0.030	0.716 ± 0.030
inelastic	0.833 ± 0.028	0.829 ± 0.018	0.807 ± 0.017

inelastic acceptance is the cross-section weighted acceptance with no cross-section error included.

Since we don't have the Run I MC available, its not feasible to update the Run I acceptance numbers.

Also wouldn't try to rescale the errors.

Efficiencies

	Run II	Run Ia	Run Ib
inelastic	0.909 ± 0.018	0.95 ± 0.02	0.907 ± 0.02

Thresholds changed between Run Ia and Run Ib

Effective Cross-Sections

$$\sigma_{eff} = \epsilon \times [A_{SD}\sigma_{SD} + A_{DD}\sigma_{DD} + A_{HC}(\sigma_{inelastic} - \sigma_{SD} - \sigma_{DD})]$$

	old	new
Run II		46 ± 3 mb
Run Ia	45.32 ± 2.02 mb	45.41 ± 2.59 mb
Run Ib	43.27 ± 1.95 mb	43.36 ± 2.49 mb

Only change is in $\sigma_{inelastic}$, σ_{SD}, and σ_{DD}.

corrections for Run I cross-sections:

	central value	error
Run Ia	0.998	1.280
Run Ib	0.998	1.275

Run I, Run II, DØ, CDF Correlations

Inelastic and diffractive cross-sections 100% correlated for all

Acceptance: almost same generators for all, probably less than 100% correlated but closer to 100% than 0% $\Rightarrow$ 100%

Efficiencies: some correlations due to similar procedures but probably small $\Rightarrow$ 0%

Run II error: 6%(correlated) $\oplus$ 2.6%(uncorrelated)

Run Ia error: 5.3%(correlated) $\oplus$ 2.1%(uncorrelated)

Run Ib error: 5.3%(correlated) $\oplus$ 2.2%(uncorrelated)